

(12) **United States Patent**  
**Kalivas et al.**

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(54) **RESTORATION OF DEFACED MARKINGS  
USING LOCK-IN INFRARED  
THERMOGRAPHY**

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(58) **Field of Classification Search**  
None  
See application file for complete search history.

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(\*) Notice: Subject to any disclaimer, the term of this  
patent is extended or adjusted under 35  
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CPC ..... **G06K 9/6215** (2013.01); **G06K 9/6202**  
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(57) **ABSTRACT**

Methods for identifying marks in a defaced metal surface by  
use of computer-implemented processing of images  
obtained according to a thermal lock-in imaging technique  
are described. Methods include processing phase images  
and/or amplitude images according to principal component  
analysis of a concatenated input matrix and development of  
a score image for each principal component determined by  
the analysis. Score images or extracted features of score  
images (e.g., Zernike moments) are compared to images/  
features in a reference data library and based upon the  
comparison, the defaced mark can be identified.

**20 Claims, 20 Drawing Sheets**

